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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte HONGXIN SONG and ZINING WU

Appeal 2009-009317
Application 10/600,419
Technology Center 2100

Before HOWARD B. BLANKENSHIP, DEBRA K. STEPHENS, and JAMES R. HUGHES, *Administrative Patent Judges*.

BLANKENSHIP, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

This is an appeal under 35 U.S.C. § 134(a) from the Examiner's final rejection of claims 1-6, 8-16, 18-26, 29-41, 43-48, 51-58, 60-68, and 71-78, which are all the claims remaining in the application. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

Invention

Appellants' invention relates to systems and techniques to interpret signals on a noisy channel. The technique includes interpreting an input signal as discrete values, and in response to an inadequate signal, averaging multiple signals to improve interpretation of the input signal. The input signal is a read signal from a storage medium, such as those found in disk drives. A read channel includes a buffer and an averaging circuit capable of different signal averaging approaches in a retry mode, including making signal averaging decisions based on a signal quality measure. Buffering read signals can be done in alternative locations in the read channel and can involve buffering of many prior read signals or buffering of an averaged read signal. Abstract.

Representative Claim

1. A signal processing apparatus comprising:

an input to receive a signal;

a buffer responsive to the input to store the signal;

a detector responsive to the input to interpret the signal as discrete values;

an averaging circuit responsive to the buffer and the detector to cause interpretation, by the detector during a retry mode, of a new signal comprising an average of a previous signal stored in the buffer and a current signal;

a control circuit that determines whether the discrete values are adequately indicated based on output of the detector, that initiates the retry mode when the discrete values are not adequately indicated, and that determines whether the discrete

> values are adequately indicated from the interpretation of the new signal in the retry mode; and
>
> an error correction circuit responsive to the detector and the averaging circuit to provide a signal quality metric that governs which signals are averaged.

Examiner's Rejections

Claims 1, 2, 9-12, 19-24, 26, 30-35, 43-46, 52-54, 61-66, 68, and 72-78 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Rothberg (US 7,136,244 B1).

Claims 3-6, 8, 13-16, 18, 25, 29, 36-41, 47, 48, 51, 55-58, 60, 67, and 71 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Rothberg and Takashi (US 6,519,715 B1).

Claim Groupings

In view of Appellants' arguments in the Appeal Brief, we will decide the appeal on the basis of claims 1 and 9. *See* 37 C.F.R. § 41.37(c)(1)(vii).

PRINCIPAL ISSUES

(1) Does Rothberg describe "an error correction circuit responsive to the detector and the averaging circuit to provide a signal quality metric that governs which signals are averaged" as recited in claim 1?

(2) Does Rothberg describe "excluding the input signal from the multiple signals to be averaged based on the signal quality metric" as recited in claim 22?

(3) Does Rothberg describe "the control circuit determines whether the discrete values are adequately indicated based on comparison of

interpretations of the new averaged signal and the current signal" as recited in claim 9?

FINDINGS OF FACT

Rothberg

1. Rothberg describes a disk drive comprising a disk having a plurality of tracks, each track comprising a plurality of data sectors. If an error occurs while attempting to read one of the data sectors, a retry operation is executed in an attempt to recover the errant data sector. Averaged read data is generated over multiple retry operations, and the averaged read data processed to recover the errant data sector. In one embodiment, the averaged read data includes an averaged binary sequence detected over multiple retry operations. In another embodiment, the averaged read data includes averaged read signal sample values generated over multiple retry operations. Abstract.

2. Figure 7 illustrates a write error where data is written askew from the centerline of the track along a serpentine path, such that reading the errant data sector with a single track offset may not recover the data from the sector. Col. 3, ll. 11-15. Figure 7 is reproduced below:

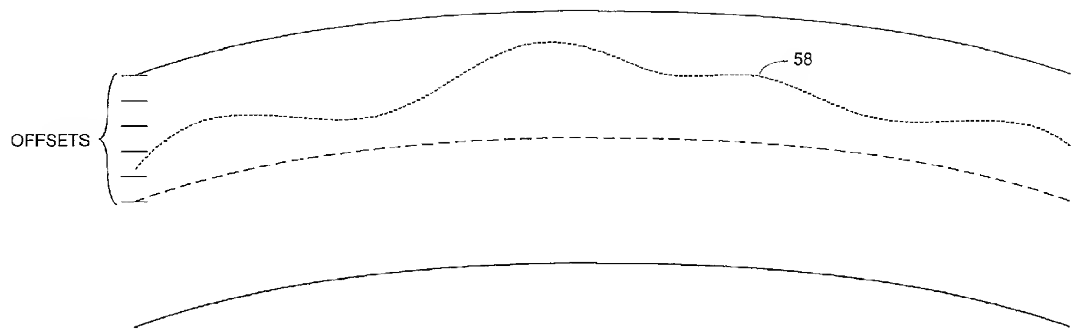

FIG. 7

4. As illustrated in Figure 7, the disk controller adjusts a tracking offset setting during the retry operations so that the servo controller maintains the head offset from centerline of the track while reading a data sector. If the head is offset from centerline during a retry operation, the data sector may be recovered without averaging the read data. However, as illustrated in Figure 7, the data may be written along a serpentine path 58 such that reading the data sector with a single tracking offset setting will not recover the data sector. If the read data is averaged for several tracking offset settings it may enable recovery of the data sector. In one embodiment, several retry operations are performed for each tracking offset setting, thereby generating averaged read data for each tracking offset setting. The averaged read data for each tracking offset setting is averaged into a final set of averaged read data. In this manner, the read data along the path 58 of the data sector having a low signal-to-noise ratio (SNR) will average toward zero leaving the averaged read data with a high SNR as the dominant component in the final set of the averaged read data. Col. 5, ll. 23-44.

5. Figure 8 is a flow diagram where the disk controller adjusts a tracking offset to at least two settings, re-reads an errant data sector multiple

times for each tracking offset setting, and averages the resulting read data to generate the averaged read data. Col. 3, ll. 16-20. Figure 8 is reproduced below.

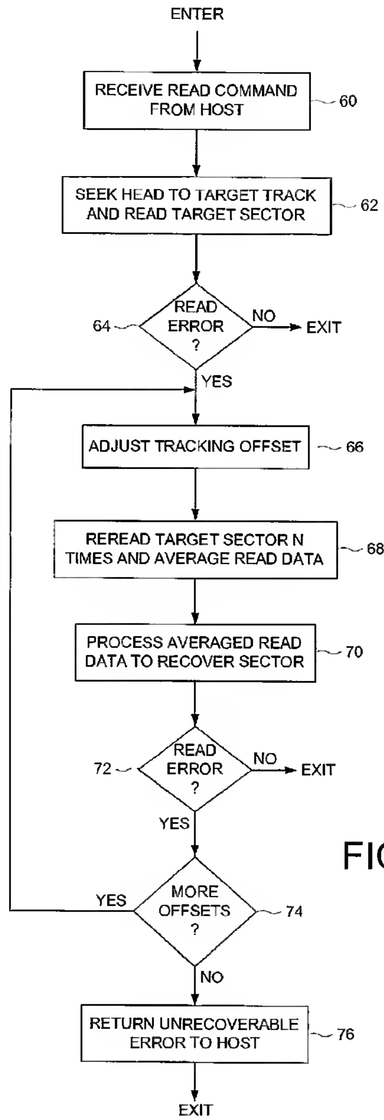

FIG. 8

6. As shown in Figure 8, at step 60 the disk drive receives a command from a host to read a data sector. At step 62, the disk controller seeks the head to the target track and reads the target data sector. If at step

64 a read error occurs, then at step 66 the disk controller adjusts a tracking offset setting. At step 68 the target sector is read N times and the resulting read data averaged. At step 70 the averaged read data is processed in an attempt to recover the data sector. If at step 72 the data sector is still unrecoverable, and at step 74 there are more tracking offset settings to try, then the process reiterates starting with step 66. In one embodiment, the target sector is read one time at step 68 and the tracking offset settings are cycled multiple times. In another embodiment, the target sector is read multiple times at step 68 over one cycle of the tracking offset settings. In yet another embodiment, the target sector is read multiple times at step 68 over multiple cycles of the tracking offset settings. If at step 74 all of the tracking offset settings have been tried, then at step 76 an unrecoverable error is returned to the host (or alternatively a different disk drive parameter is adjusted over a number of retry operations). Col. 5, l. 45 - col. 6, l. 3.

PRINCIPLES OF LAW

Claim Interpretation

During examination, claims are to be given their broadest reasonable interpretation consistent with the specification, and the language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art. *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004) (citations omitted). The Office must apply the broadest reasonable meaning to the claim language, taking into account any definitions presented in the specification. *Id.* (citations omitted).

Anticipation

"Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1458 (Fed. Cir. 1984).

ANALYSIS

Section 102(e) rejection of claims 1, 2, 9-12, 19-24, 26, 30-35, 43-46, 52-54, 61-66, 68, and 72-78

Appellants contend that Rothberg does not disclose an error correction circuit responsive to the detector and the averaging circuit to provide a signal quality metric that governs which signals are averaged as recited in claim 1. In particular, Appellants contend that the reliability metrics of Rothberg are the result of an average; therefore, the reliability metrics are not equivalent to the claimed signal quality metric that governs which signals are averaged. App. Br. 13-16; Reply Br. 2-3.

Figure 8 of Rothberg shows a method of adjusting a tracking offset during a retry operation. After adjusting the offset, the target sector is read multiple times and the resulting read signals are averaged. The method then determines if the data can be recovered from the averaged read signals. If the data is still not recovered, the process adjusts the offset again, reads additional signals, and includes the additional signals in the average. On the other hand, if the data is recovered, the process ends, and no additional signals are included in the average. FF 5, 6.

Determining if the data is recovered, or is not recovered, is a signal quality "metric" that governs whether additional signals are read and

averaged. Therefore, Rothberg describes a "signal quality metric that governs which signals are averaged" within the meaning of claim 1.

Accordingly, we sustain the rejection of claim 1 under 35 U.S.C. § 102(e). Appellants have not presented arguments for separate patentability of dependent claims 2 and 11, which thus fall with claim 1.

For independent claims 12, 34, and 53, Appellants rely on the arguments presented for claim 1, which we find unpersuasive. App. Br. 16, 18, 19. Therefore, we sustain the rejection of claims 12, 34, and 53 under 35 U.S.C. § 102(e). Appellants have not presented arguments for separate patentability of dependent claims 21, 35, 54, and 63, which thus fall with claims 12, 34, and 53.

For independent claim 22, Appellants first rely on the arguments presented for claim 1, which we find unpersuasive. App. Br. 17. Appellants further contend that Rothberg does not describe "excluding the input signal from the multiple signals to be averaged based on the signal quality metric" as recited in claim 22. App. Br. 17; Reply Br. 4.

Figure 8 of Rothberg shows a method of adjusting a tracking offset during a retry operation. After adjusting the offset, the target sector is read multiple times and the resulting read signals are averaged. The method then determines if the data can be recovered from the averaged read signals. If the data can be recovered, the process ends. FF 5, 6. Thus, no additional signals are read, and no additional signals are included in the average. In other words, the method is "excluding" the additional signals from the average within the meaning of claim 22. Therefore, Rothberg describes "excluding the input signal from the multiple signals to be averaged based on the signal quality metric" as recited in claim 22.

We sustain the rejection of claim 22 under 35 U.S.C. § 102(e). Appellants have not presented arguments for separate patentability of dependent claims 23, 24, 26, and 33, which thus falls with claim 22.

For independent claims 45 and 64, Appellants rely on the arguments presented for claims 1 and 22, which we find unpersuasive. App. Br. 18, 19. Therefore, we sustain the rejection of claims 45 and 64 under 35 U.S.C. § 102(e). Appellants have not presented arguments for separate patentability of dependent claims 46, 65, 66, 68, 75, and 78, which thus fall with claims 45 and 64.

For independent claim 9, Appellants contend that Rothberg does not describe "the control circuit determines whether the discrete values are adequately indicated based on comparison of interpretations of the new averaged signal and the current signal" as recited in claim 9. App. Br. 20; Reply Br. 6.

Claim 9 recites "comparison of interpretations of the new averaged signal and the current signal." However, claim 9 does not recite that the interpretations of the new averaged signal and the current signal are compared to each other. The scope of claim 9 therefore encompasses comparison of the interpretation of "the new average signal" to something, comparison of the interpretation of "the current signal" to something, and determining whether discrete values are adequately indicated from "comparison of interpretations."

Figure 7 of Rothberg shows multiple offset settings that can be used to recover data. The data read from the multiple offset settings are averaged together, and data can be recovered from the averaged read data. However, Rothberg also states that if the head is offset from the centerline during a

retry operation, data may be recovered without using the averaged read data. Rothberg thus implicitly describes a comparison of the current signal to some type of recovery threshold to determine whether data can be recovered, and if not, comparing the averaged read data to a recovery threshold to determine whether data can be recovered. FF 2, 3. Therefore, Rothberg describes "the control circuit determines whether the discrete values are adequately indicated based on comparison of interpretations of the new averaged signal and the current signal" within the meaning of claim 9.

We sustain the rejection of claim 9 under 35 U.S.C. § 102(e). Appellants have not presented arguments for separate patentability of dependent claim 10, which thus falls with claim 9. Appellants have also not presented arguments for separate patentability of claims 19, 20, 30-32, 43, 44, 52, 61, 62, 72-74, 76, and 77, which thus fall with claim 9.

Section 103(a) rejection of claims 3-6, 8, 13-16, 18, 25, 29, 36-41, 47, 48, 51, 55-58, 60, 67, and 71

For claims 3-6, 8, 13-16, 18, 25, 29, 36-41, 47, 48, 51, 55-58, 60, 67, and 71, Appellants rely on the arguments presented for claims 1 and 9, which we find unpersuasive. App. Br. 22-23. Therefore, we sustain the rejection of claims 3-6, 8, 13-16, 18, 25, 29, 36-41, 47, 48, 51, 55-58, 60, 67, and 71 under 35 U.S.C. § 103(a).

CONCLUSIONS OF LAW

(1) Rothberg describes "an error correction circuit responsive to the detector and the averaging circuit to provide a signal quality metric that governs which signals are averaged" as recited in claim 1.

(2) Rothberg describes "excluding the input signal from the multiple signals to be averaged based on the signal quality metric" as recited in claim 22.

(3) Rothberg describes "the control circuit determines whether the discrete values are adequately indicated based on comparison of interpretations of the new averaged signal and the current signal" as recited in claim 9.

DECISION

The rejection of claims 1, 2, 9-12, 19-24, 26, 30-35, 43-46, 52-54, 61-66, 68, and 72-78 under 35 U.S.C. § 102(e) as being anticipated by Rothberg is affirmed.

The rejection of claims 3-6, 8, 13-16, 18, 25, 29, 36-41, 47, 48, 51, 55-58, 60, 67, and 71 under 35 U.S.C. § 103(a) as being unpatentable over Rothberg and Takashi is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 41.50(f).

AFFIRMED

msc